Minutes taken by Trisha De Graaf on 04/24/14 and revised by Trisha De Graaf on 03/28//14.

Sea Urchin Zone Council Research Subcommittee Meeting
April 24, 2014 in West Boothbay Harbor

DMR staff: Trisha De Graaf, Maggie Hunter and Robert Russell.

SUZC members: Teresa Johnson, Clint Richardson, Dean Norris, Steve Eddy, and Larry Harris.

Public: Jim Wadsworth, and Schyler Belle. Graham Morehead

Meeting commenced at 1:10pm.

Graham Morehead gave a presentation on a modeling effort focusing on harvesting strategies for a sustainable fishery [Slides in Appendix A]:

White is land, grey is water. Spoke to 17 fishermen, and some draggers. Snapshot from simulation shows seaweed in green, urchins in red. Each pixel is 20x20m. Brighter green = more seaweed, more red is more urchins. May be some mixed cells. Simulation region was identified by fishermen as a good fishing spot, white is above the high tide mark. This is a snapshot of model, not reality. Von Bertalanffy growth function was put into the model and accounts for growth, reproduction, a number of parameters in the model, i.e. predation rate, gonad size, seaweed recruitment, tide, etc. Model accounts for 14 species of seaweed, but mostly weighted to the one preferred species, sugar kelp. In simulation you can see what things were like in the early 1980s, and most of it is urchin barren. Moving ahead in time you see the red areas depicting urchins disappears quickly, and seaweed taking over, so just a small area that is in the red. Depending on area, you can have up to $1/m^2$, but are not able to maintain an urchin barren. Kelp state has much more predation, staying in a stable kelp bed state. The model had 12 size classes up to 76mm.

If you have the circular patterns of harvesting and run the same simulation what we see over the year is that harvesters extract almost the same number of urchins, but at the end of the year there are some solid feed lines. If you let the urchin site rest for a year, then they come back very well with a healthy GI on average 22% compared to 8.6% under a standard harvesting practice. Then looked at it once a month for 10 years, and you can see are marked difference after just one year. Urchins have enough time to redistribute themselves after harvest to maintain a feed line as they have time to move to the spaces where they were harvested from.

For more information, see Graham's YouTube Video here: https://www.youtube.com/watch?v=ZYsrTDQciUo

D. Norris: There are a couple of different kinds of fishing methods. One is that someone is insecure and they find a spot and destroy it. Other method is to take the cream and leave urchins and move on. I think it is hard to change people from one method to another. I don't see any way to have people do a circular method.

J. Wadsworth: What about just using closed areas?

D. Norris: But that can focus the effort.

R. Russell: This method does not require closures; it just means to leave enough biomass after you go through and harvest.

D. Norris: Is it based on one or multiple divers?

G. Morehead; It can be multiple divers, as long as enough is left over.

D. Norris: People in 1980s who worked on volume really hurt the biomass. In 1991 people came in and wiped them out. I don't know of any practical way to get folks to do this other than culling on bottom, tote limits, etc… It takes a long time for people to learn this and if people have made money one way, it is hard to get them to change.

L. Harris: I collaborate with a guy in Portsmouth who is one of the original NH harvesters and his approach is what you describe. Go to feed line and harvest all the high quality urchins, and you didn't touch the barren urchins below. This is the way Nova Scotia set up their lease sites and Scheibling talks about after a die off urchins moving up. You have a gradient with deeper animals that can migrate up. He was making a very good living; until other people arrived and they wouldn't leave anything, take everything right down to the barrens, no rotational system possible any more. That is when you got the alternate stable state coming back. Not everyone is willing to buy in and the only way to make this happen is you first need monitoring and assessment, establish a strategy and monitor to see if this concept would work. It really depends on the area's topography, if lots of urchins across an area like Cobscook, then banding or circular harvest should work. But If in Casco Bay with a thermocline at about 30 ft where urchins can move up as in a conveyor belt, then must only take after they have reformed a feed line shallower….

M. Hunter: Did you account for sublegal urchins?

G. Morehead: 10% chance they may be accidentally caught.

M. Hunter: Could you play with minimum size limit?

G. Morehead: Yes, I am here to get your feedback.

D. Norris: People have changed the way they have fished recently. With a tote limit, folks have been making more money as they are getting more money for their urchins. Biggest opponents are now big proponents of tote limits.

M. Hunter: The critical piece is you need to leave a swath untouched.

D. Norris: People can make a good living on $1/m^2$, which is not biologically viable.

S. Eddy: Does it account for draggers?

G. Morehead: No.

M. Hunter: But draggers can leave large swaths behind around boulders. Areas where they are mostly dragging, like Downeast, is the area that there are urchins remaining. May be more deep urchins there?

D. Norris: They can move the rocks and get those urchins now.

T. De Graaf: The two forms of harvest together are effective at removing the majority of urchins in an area. Not unlike what happens in scalloping.

L. Harris: Jonah crabs are biggest threat.

M. Hunter: When you fish leaving the swath, you end up catching 97% of what you caught fishing without the swaths.

G. Morehead: But with the circular harvest pattern, the biomass is way above.

M. Hunter: If you fished the first year and you leave 3% less (randomly), you won't get as good a result as leaving 3% less in a swath . There is something about leaving them in an untouched "clump" that is important.

G. Morehead: Correct, and you don't get the flip from the barren to kelp state.

L. Harris: But no one has figured out what is the critical density. You're assuming you are taking and clearing everything out, when nowadays you have to leave sublegal or oversize.

G. Morehead: This leaves those, only takes legal sized urchins.

D. Norris: Folks have already changed their style of fishing. With the tote limit, people are more likely to leave more behind. I think there has been a transition with tote limit, it is slowing people down. You have to get good totes; you need to focus on quality. You take the cream and move on, and used to be you took everything.

R. Russell: Will areas that were below economic threshold before now be consider if it's 5 urchins/m^2? Will they now become exploitable if folks can make a living at the lower amount of harvest?

D. Norris: Abe is depressing the Yen in Japan, so prices are on the way down. But best prices are the guys who get to the trucks first before they fill up.

M. Hunter: What is different about having a "clump" of urchins left behind vs. an urchin here and there?

D. Norris: Right before they spawn they all aggregate, they move a lot.

G. Morehead: There is no simple way to look at it. For any urchin size we have an idea of how much they consume. Depending on the depth, we know how fast seaweed would grow, how much each urchin would eat and we put them together. Out of all that research in the fishery taken over last 20 years on growth and urchin eating, we put that together and there are seasonal effects.

S. Belle: What seaweed species?

G. Morehead: we looked at 14. Sugar kelp was the one we looked at the most.

D. Norris: Problem with patterns is that the urchins are not distributed evenly like that anymore.

L. Harris: What you have is a model and that is a hypothesis. We are here to initiate trial restoration efforts in Zone 1 and to test its feasibility. In Zone 2 there is a glaring example of a trial that did not go very well because Whiting & Dennys Bays were not monitored ahead of time and then it was left open for rape and pillage. But that is the type of bottom where you could test bands, not sure about circular harvest. The important part is to have the monitoring. You could do it with divers and draggers and have buoys showing where you can tow to see if urchins will do what is predicted. It is a testable hypothesis. If there is going to be any kind of restoration efforts in Zone 1, one could do it the normal way of harvesting, or one could set up a trial where you harvest in a patch strategy. What you have is a hypothesis that could be tested, but if it is, there needs to be monitoring and buy in by local harvesters in that area.

G. Morehead: If an area was chosen, I would want to do a rigorous assessment – how many urchins, kelp, etc. Then we start fishing and try the different simulations.

M. Hunter: We tried something similar with Marcus Jones as a Northeast Consortium project, but the report was not published. Three lanes, one with straight raking, one with size-selective fishing and one with no fishing. We monitored before, then a week, month and year later. Results were inconclusive because three lanes were touching, so urchins could move between and it confounded the results. In a few places, there some promising results. It is the clumps or density that is left behind. John Vavrinec concluded around 300 grams/m^2 was the tipping point where it would flip from an urchin barren state to a kelp dominated state at Pemaquid in 30 ft; Scheibling has something different as well.

G. Morehead: It really depends on the size of the area. If you are a wolfish and harvesting an urchin here and there, it is fine. In most of my simulations, where there were areas of heavy harvesting, we have not seen a recovery after 2 years.

L. Harris: In 10 years I haven't seen it recover at all.

R. Russell: Look at Western Maine.

G. Morehead: Urchins need a predator, they will starve and it will all be barrens.

S. Eddy: You need to harvest the kelp for biofuels.

T. De Graaf: You need a dynamic state.

L. Harris: Can you restore areas by letting a group of divers manipulate the bottom and have a ledge or a series of ledges to work on? There was a lot of resistance in the past, especially in regards to moving urchins from "bad" areas to good ones. At the last meeting, some of the most vocal opponents have now expressed interest in doing something like this? The ecosystem has changed and the standing stocks are not as productive as they once were. We have lost the larval supply.

T. Johnson: How can we take the lessons learned from Graham's work and apply it to this project?

D. Norris: I think the proposal at the last meeting of closing an area, like Dyer Bay may be a way to look at this. I think it is important to involve the fishermen in what is happening in that area.

S. Eddy: Should have a research area in Zone 1 and one in Zone 2 as well.

L. Harris: Closing an area with no urchins currently and reseeding it is one idea vs. taking a common resource and then working on it and making it exclusive to those that do the work is a very different idea.

D. Norris: You need a mechanism to return it to the wild fishery, but you need to provide some benefit back to those that do the work.

C. Richardson: I don't agree with that. I will do the work for nothing.

T. De Graaf: There would be a benefit to the whole fishery if we were successful.

R. Russell: Why can't you take oversized urchins which are not commercially viable?

M. Hunter: They are still providing reproductive benefits.

L. Harris: Idea is to have a research area that is fishermen initiated. Funds from SUZC Research Fund to buy a couple of totes from participating fishermen that could be the seeding and then purchase of hatchery animals after the bottom has been disturbed in the winter, and recruitment in the spring. You seed into the areas that have been disturbed in the winter and have some larger adult urchins and look for the recruitment in the spring. May only be one or two or three urchins and it is a no-fish zone for a period of time for a finite time. But guys who put the effort in should have the ability to harvest them. Best time to move urchins is in the winter.

R. Russell: Clint wanted to do work on Cat Ledge and our survey is in a couple of weeks and we could cover that area.

L. Harris: That fits my concept. It is initiated by a fisherman who is experienced and willing to make an effort [Clint]. It is in a good area to make it simple for DMR.

C. Richardson: I could get all the urchins I need on the other side of the river for that site too.

S. Eddy: I think you need something more broad scale with multiple sites across the state and have it for a long time period.

D. Norris: Goal is not to move bad urchins to a good area to bulk them up. It is to try to see if we can bring an area back. Dyer Bay and Petit Manan will have a really high potential payoff as it used to be 50 boats working there back in the day.

R. Russell: There is a lot of kelp there; it is the perfect alternate state.

S. Eddy: How would the process work?

T. De Graaf explained rulemaking and need to coordinate with possibly other fisheries on a long term conservation closure area. Also, could move the urchins under a special license.

R. Russell: We have a special license already that we can work under.

L. Harris: You do it in the winter when there are no crabs, and adult urchins have disturbed the bottom and exposed hard substrate. You move in some more adult urchins as well as some juvenile hatchery stock.

S. Eddy: Ideal size is 10-15mm, but smaller is cheaper and they are harder to mark them, which you need to do to measure your success. 10-15mm you can definitely see the mark down the road. You may get better results if you have a range of sizes.

D. Norris: The worst junk bed is a mix of smalls.

S. Eddy: Better question is how much is the industry willing to pay? That will depend how much you will get.

C. Richardson: Cat Ledges has a lot of kelp, just not a lot of drift kelp. There are a lot of pin mussels there.

R. Russell: There is a big slope wall on outer edge of Cat Ledges covered in pink coralline algae. I expected to find urchins at the feed line and they were not there. There is a lot of "fuzz", not good sugar kelps and Didemnum. Anywhere in this whole area you are going to have that problem.

D. Norris: What about Goose Rock Ledges?

R. Russell: Hard place to work.

C. Richardson: Nothing left there.

L. Harris: If you put urchins in there this winter, you would be able to look at recruitment of natural settlement next summer by putting plates down there, I can provide them and can bring them on June 5. We could retrieve them in late summer and see what we get. Next summer after there are urchins in there we can look at urchin distributed sites vs. non-disturbed sites to see if there are recruits with quadrat surveys. You should see them by next summer if they are visible. At same time we can pursue the idea of seeding.

C. Richardson: I think it is a place to start.

S. Eddy: Might need 3 or 4 adult animals per square meter based on needing 300 g/m to maintain the urchin barren, and with several totes, that is a sizeable area.

L. Harris: I would think less than 30 feet to maintain the kelp. Ok, so we have the outline of a plan to present to the rest of the council.

S. Eddy: I still think we need to do this in Zone 2.

T. De Graaf: But if we want to get something underway right now, we need to start in Zone 1 as this area has no commercial activity. Think of it as a proof of concept project to just see if we can do it and get the project underway, and we have the conversation with Zone 2 for something down there.

L. Harris: Ok, we will talk about it at the next SUZC Research Subcommittee and then for the full council.

T. Johnson: I think it was a good conversation but monitoring is going to be key.

L. Harris: We have Robert engaged for that and we can even do a go pro.

T. De Graaf: I will talk to Brian Preney about making sure this topic gets on the full SUZC meeting agenda at the next meeting which is June 5 and will make sure he has the chance to review these minutes.

Meeting convened at 3:45pm.

Appendix A
Graham Morehead Slides

A Complex-Systems Approach to Simulating the Sea Urchin Ecology

By

Graham Andrew Morehead

BA, Boston University, 1995

A THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Science
(in Computer Science)

The Graduate School

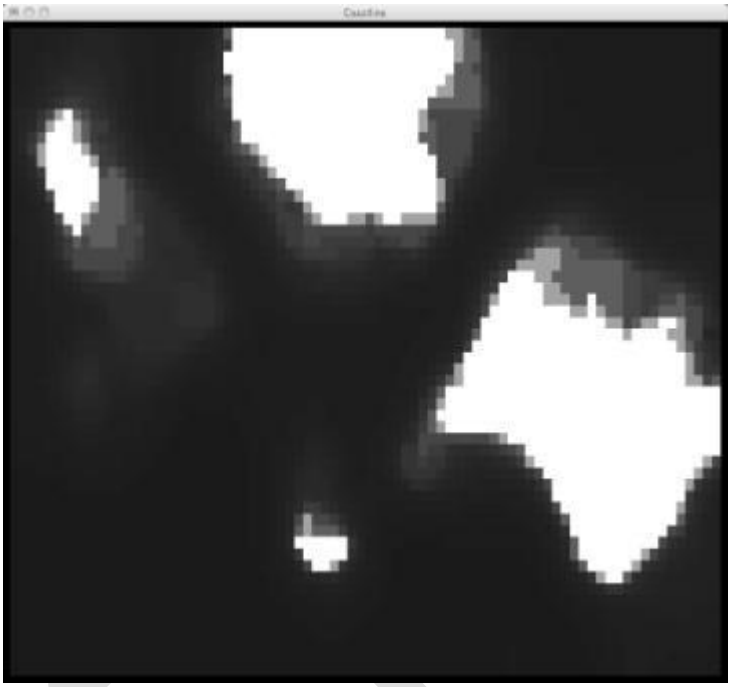
The University of Maine

May 2014

(Alphabetically by name)

Amy Johnson
Bob Steneck
Brian McGill
Caitlin Cleaver
Christian Wilson
Clare Bates Congdon
Jack Hill
James Acheson
James Wilson
Jui-Han Chang
Lawrence Latour
Larry Whitsel
Lucas Kaim
Margaret Hunter
Peter Hayes
Robert Russell
Robert Vadas
Roy Turner
Ted Ames
Teresa Johnson
Tim Waring
Yong Chen

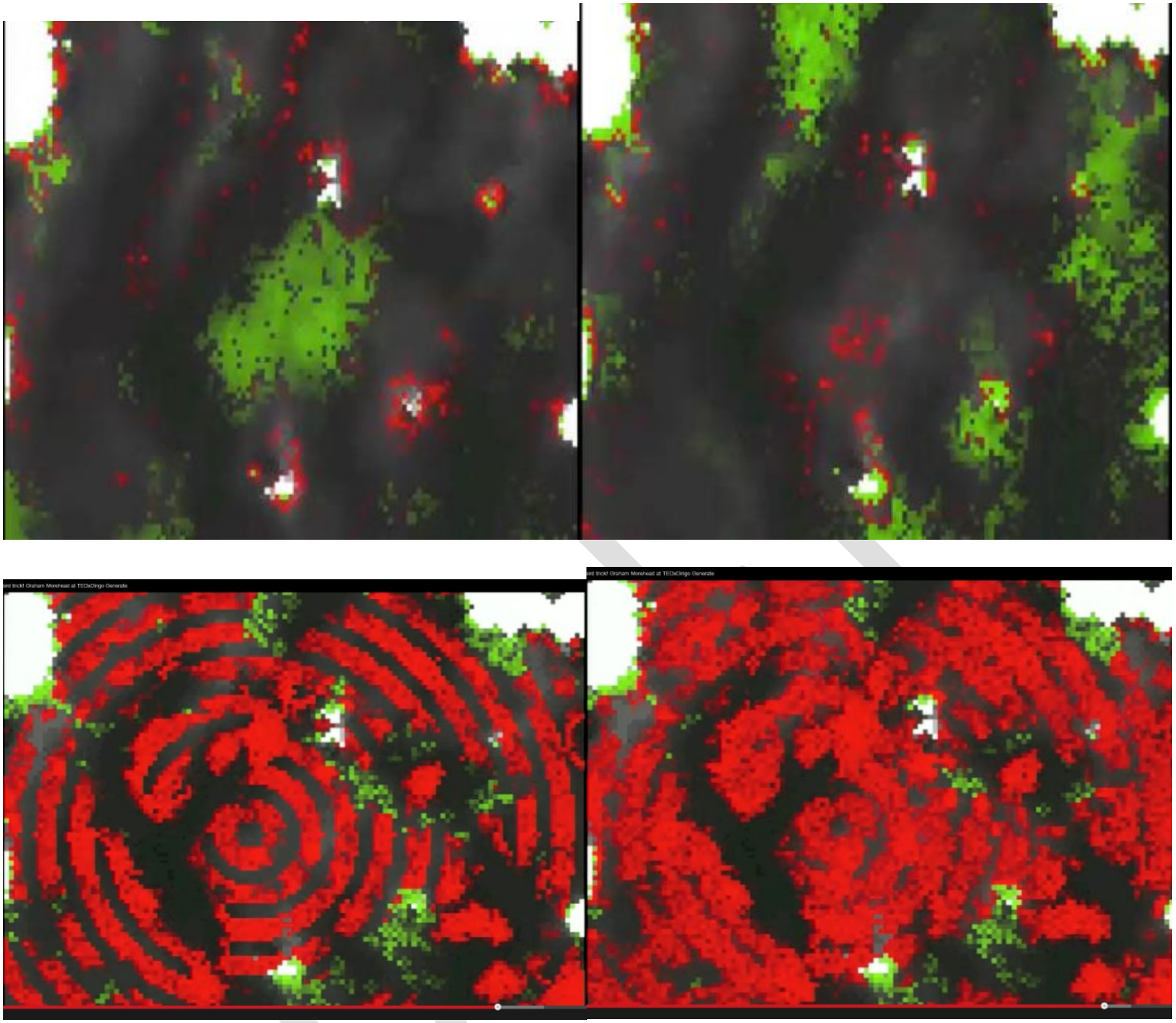
Minutes taken by Trisha De Graaf on 04/24/14 and revised by Trisha De Graaf on 03/28//14.



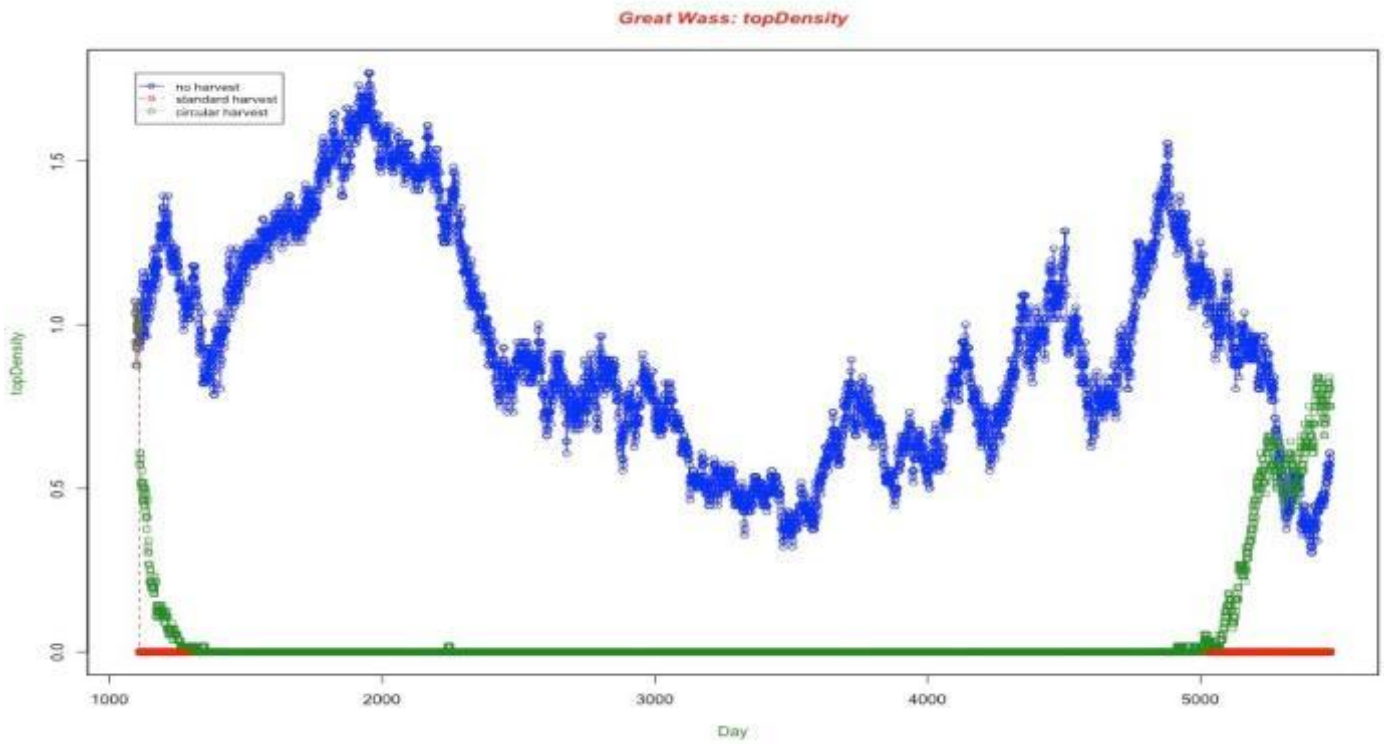
PARAMETER	ESTIMATE	RANGE
byCatchLoss	0.2	0.1 - 0.3
herbivoryRate	$0.00005\,min^{-1}$	$2.3 \times 10^{-6} - 7.7 \times 10^{-5}$
K (Brody Growth Parameter)	$4.5 \times 10^{-7}\,min^{-1}$	$2.2 \times 10^{-7} - 6.2 \times 10^{-7}$
lowGonadIndex	1	0.5 - 2
maxBiomassDensity (Seaweed)	$0.8 \frac{kg\,(dry)}{m^2}$	0.32 - 1.0
maxGonadChangePerMin	$4.75 \times 10^{-7}\,min^{-1}$	$3.87 \times 10^{-7} - 5.39 \times 10^{-7}$
maxGonadIndex	25	18 - 27
maxPredationPerMin	4×10^{-7}	3.0×10^{-7} - 5.0×10^{-7}
maxPredationPerMin-juv	0.106	0.08 - 0.12
maxTotalNumDensity	$500 \frac{urchins}{m^2}$	100 - 1000
maxSize	85 mm	63.1 - 95.2
minGonadIndex	1.0×10^{-12}	0.0 - 1.0×10^{-5}
mortalityRatePerMin	$1 \times 10^{-8}\,min^{-7}$	$4.05 \times 10^{-9} - 4.05 \times 10^{-7}$
photic function	$e^{7.05-0.17d}$	$e^{7.0-0.13d} - e^{7.1-0.27d}$
predationRatePerMin	$1.5 \times 10^{-7} \frac{urchins}{m^2 min}$	$7 \times 10^{-8} - 4 \times 10^{-7}$
predationRatePerMin-juv	$0.05 \frac{urchins}{m^2 min}$	0.0193 - 0.106
probRecoverPerMin	$7.0 \times 10^{-6}\,min^{-1}$	$3.4 \times 10^{-6} - 1.4 \times 10^{-5}$
recruitmentRate	$0.04 \frac{urchins}{m^2 \cdot min}$	0.0057 - 0.086
timeToMaxBiomass (Seaweed)	600 days	55 - 5075
turbulentZone	2 m	1 - 3

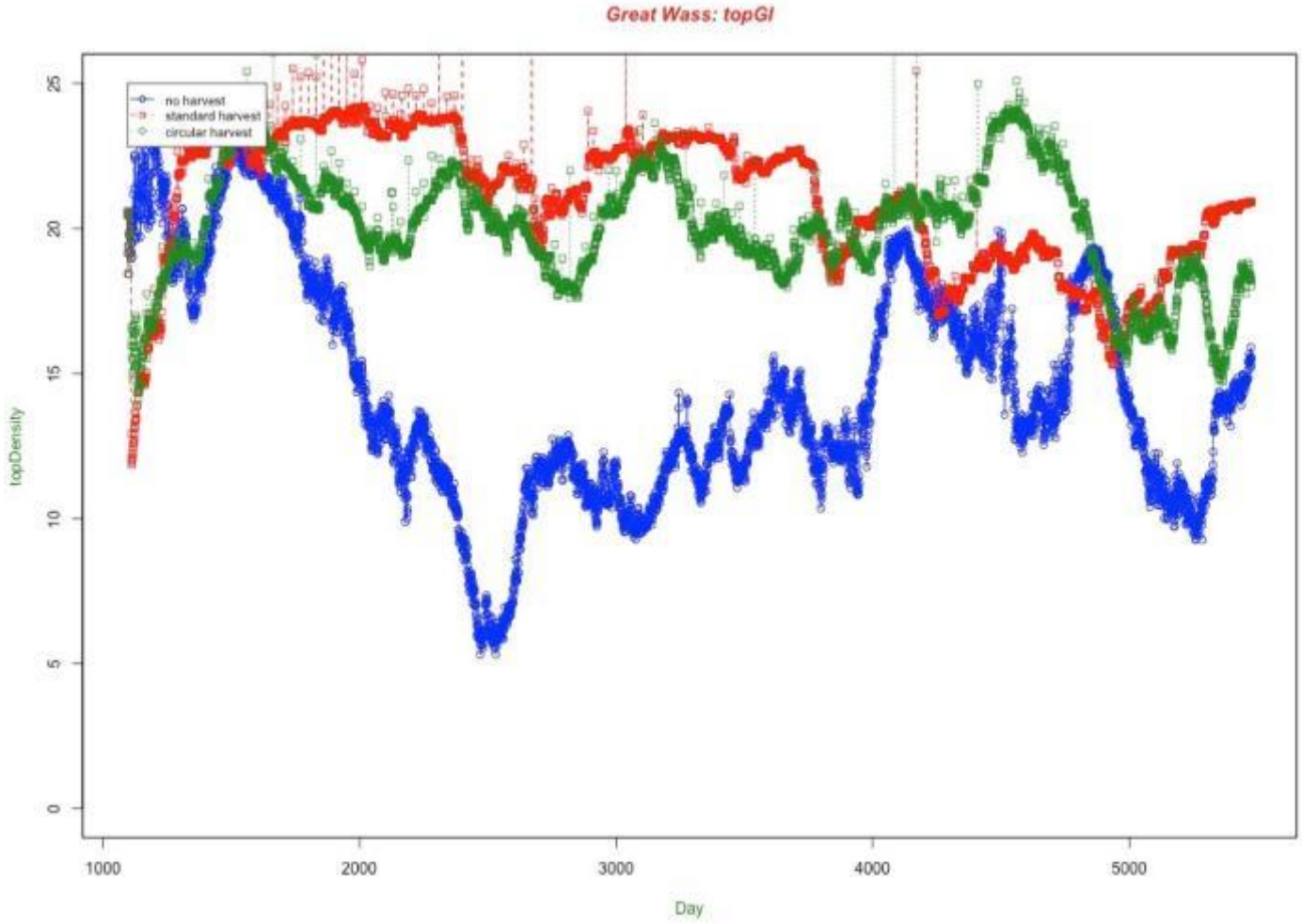
$$L_t = L_\infty \left(1 - e^{-K(t-t_0)}\right)$$

Minutes taken by Trisha De Graaf on 04/24/14 and revised by Trisha De Graaf on 03/28//14.



Minutes taken by Trisha De Graaf on 04/24/14 and revised by Trisha De Graaf on 03/28//14.





Minutes taken by Trisha De Graaf on 04/24/14 and revised by Trisha De Graaf on 03/28//14.